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Smart Metering for Electric and Gas Utilities

Introduction

Should utilities replace current consumption meters with “Smart Metering” systems that provide more information to both utilities and customers?

This question is one of the most hotly debated in today’s utility industry. It is complicated by the fact that there is no single definition of Smart Metering and that no single definition works well within all market structures. It is also complicated by differing views on the value of additional information to customers and utilities.

This paper explores the use of new approaches to consumption metering that provide utilities and customers with information generally unavailable today.

Smart Metering Defined

Because there are so many current definitions of Smart Metering, let us begin by defining what it is not. Smart Metering is not:

- An electromechanical single-read or time-of-use meter that displays consumption totals read periodically by a human meter reader.
- An Automatic Meter Reading (AMR) system in which meters communicate their monthly or daily consumption totals to a central collector using one of a number of different communications techniques, such as radio signals, power-line communications, or satellite reads.

In today's global utility industry, Smart Metering generally indicates the presence of one or more of the following

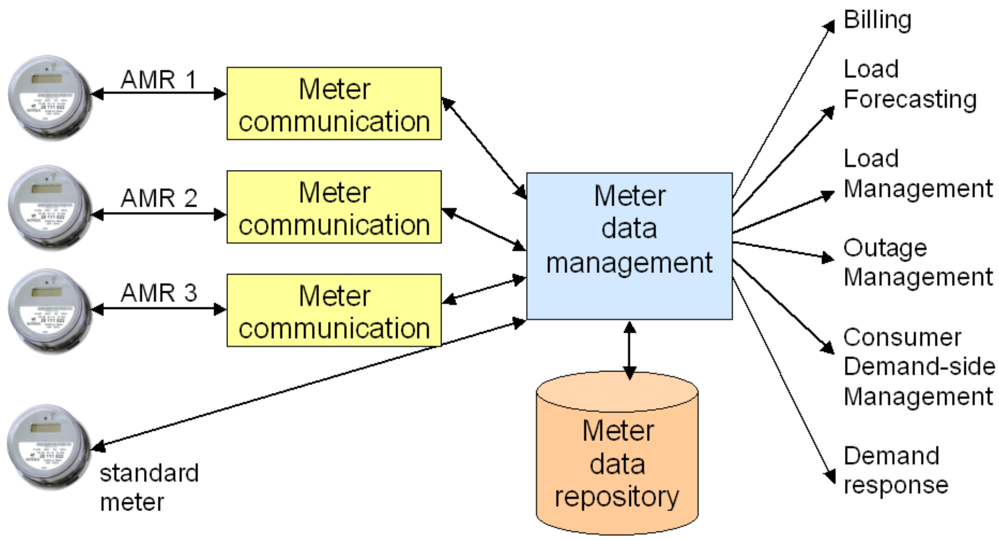
- Any consumption meter linked to a device that informs the customer in real time about current use, consumption during a specific period, consumption trends, and/or other information designed to help the customer manage energy and water costs and usage.
- Interval meters that measure consumption during specific time periods (e.g. every 15 minutes, every hour) and communicate it to the utility at least daily.
- A one-way communications channel that permits the utility, at a minimum, to obtain meter reads on demand, to ascertain whether energy or water is flowing through the meter and onto the premises, and to issue commands to the meter to perform specific tasks such as disconnecting.

Some in the industry further restrict Smart Metering by requiring:

- A two-way communications channel between the utility and the meter that can be activated from either end.
- Stand-alone data collection and processing software, such as a Meter Data Management application. This isolates the existing billing system from the increasing meter data volumes that smart metering introduces.
- Deployment of an advanced application over a substantial percentage of a customer class. Those applying this restriction do not see the use of interval billing by a few large industrial customers as Smart Metering, generally because these programs may use individually contracts administered by key account representatives and do not necessarily rely on the highly

sophisticated software applications required when large numbers of customers use interval billing.

Some analysts equate Smart Metering with Advanced Metering Infrastructure (AMI), a hardware and software system that includes meters on one end and data-using applications on the other.



An Advanced Metering Infrastructure (AMI) facilitates the movement of meter data across the organization.

Why Use Smart Metering?

Information to the Customer

The simplest form of Smart Metering gives the customer real-time consumption information via a display device that translates the meter reading into a form the customer can easily understand.[1] The goal of this device is to help customers to change their consumption, should they wish to do so, without having to wait for the end of the month or the end of the quarter to view the results from conservation initiatives. Displays tailored to the specific needs of the user, such as those

[1] For example, Britain's Office of Gas and Electricity Markets (Ofgem) defines smart metering to include "[s]imple devices [that] consist of displays that can be connected to existing meters and can provide customers with a read out of how much energy they are using and what it is costing." Domestic Metering Innovation – Next Steps, Ref: 107/06, 30 June 06, http://ofgem2.ulcc.ac.uk/temp/ofgem/cache/cmsattach/15591_Metering_Innovation_Decision_document_final.pdf?wtfrom=/ofgem/whats-new/archive.jsp

comparing current use with neighborhood averages or with consumption in previous months, may help consumers further focus on conservation.

Some utilities have offered this sort of display equipment for sale or as a promotion. The European Union (EU), in both the Measuring Instruments Directive and in Article 13 of the Energy End Use Efficiency and Energy Services Directive, has mandated this sort of information provision to customers. EU members, however, have been somewhat slow to implement this policy.

Information about the long-term effects of this equipment on consumption is not readily available.

Information to the Utilities

Utilities can use time-of-use or interval data to better analyze and manage supply portfolios and the scheduling of generation or supply withdrawal from storage fields or reservoirs.

Interval data matched to customer type and location is particularly helpful in identifying needs for network or pipeline repairs or changes. It can also point to the location and size of leaks or theft.

Some Smart Metering systems permit meters to send “last gasp” messages when they are going out of service. These help utilities identify the location and extent of an electrical outage or a break in a water or gas main.

Utility Cost-Cutting Initiatives

Utilities frequently use a Smart Metering communications network to obtain an off-cycle, “final” meter read for customers moving or leaving the area. It is common to couple these real-time final meter reads with web sites for on-line bill payment or with call centers that accept payment over the phone. Utilities frequently find it is easier and less costly to obtain rapid final payments from customers before they leave the area.

Remote meter disconnects are another cost-saving feature of many Smart Metering systems. These reduce the costs to send field crews to the premises of customers who have either requested a disconnect or who are being disconnected (or ratcheted back) for bill nonpayment.

Smart Metering applications often permit utilities to check meter status (“ping the meter”) prior to sending a repair crew in response to a customer call. These checks prevent needless field crew dispatch to customer sites where problems are not the utility’s responsibility.

Most Smart Metering applications permit remote theft-detection tests geared to the type of meter and the type of utility service. They can ensure that almost all bills are based on actual meter reads rather than on estimates; this reduces calls to the contact center and improves customer satisfaction.

New Products and Services

Smart Metering systems can frequently accommodate prepayment meters with multiple options for payment, such as recharging or via Internet or telephone, and with emergency overrides. Some utilities are looking at the possibility that a single prepayment meter for gas, water, and electricity may bring down the total cost of prepayment and permit utilities to respond cost-effectively to an option many consumers request as a tool to help them budget.

Smart Metering for Electric Utilities

Cost Reduction through Demand-Response Programs

Demand-Response programs are designed to solve two interlocking problems of today's electricity industry:

- Peak wholesale prices that raise the average price customers must pay for electricity.
- Peak grid use that creates blackouts and the need for costly grid expansion.

Utilities are seeking ways to keep electricity affordable despite rising demand that creates upward price pressures.

The Cost Issue

Electricity costs are rising in most markets because rising demand is outpacing supply. In some regions, peak demand is growing at twice the rate of overall energy usage. The problem is particularly acute in electricity because:

- Environmental regulations slow or prohibit the development of fossil-fuel generating plants and hydropower in some areas.
- Non-hydro renewables in most regions provides an inadequate substitute for fossil fuels and hydropower because of problems in dispatchability, distance from major population centers, cost, and technical inefficiency.

In some markets, private generation companies exist to fill gap between supply and demand with generation priced at hundreds or thousands of times the usual wholesale price of electricity in that market. Distributors and retailers must purchase this generation because of their regulatory or contractual "obligation to serve"—that is, under a requirement to provide as much electricity as customers demand. Current electricity market norms, however, often make it difficult for both regulated utilities and retailers to recover the full cost of high-priced peak generation.

Exposing Customers to Peak Prices

Demand-Response programs solve this problem by exposing customers to these volatile peak generation prices. Customer consumption is measured in intervals that can each, in theory, carry a price that reflects the distributor's or retailer's wholesale electricity price plus overhead.

Demand-Response may involve direct participation in the wholesale market for the very largest industrials. The vast majority of electricity users, however, choose among various utility-designed Demand-Response pricing schemes. Prices may vary throughout the day on a regular schedule altered monthly or seasonally. Utilities may also build in "critical peak" pricing periods that coincide with periods of anticipated high demand. These are generally scheduled a day in advance. Customers using electricity during these periods pay prices considerably higher than the norm. Because customers reduce consumption in response to these prices, distributors and retailers do not have to buy as much generation as they otherwise would to fill the gap between demand and their contractual supply. That lowers the peaks and reduces peak prices.

Reducing peaks has a simultaneous effect on the grid, lowering the need for capacity to service peak use.

In electricity, Demand-Response programs are a primary driver behind Smart Metering. Their success with large industrial and commercial customers is proven and popular, and their use with residential customers is growing.[2]

The success of Pilot programs and large scale direct load control programs are leading to the planning and implementation of large scale demand response programs in many regions.

Outage Detection and Grid Efficiency

Communications from the meter permit utilities to identify outages rapidly and to pinpoint the location of outages and nested outages. They also permit utilities to follow up to check that outages have been resolved at every meter location.

Analyses of interval meter data avoid grid over-engineering, and refine load balancing and forecasting. They help engineers identify and resolve bottlenecks and other inefficiencies, thus

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[2] UtiliPoint analyst Patti Harper-Slaboszewicz notes, for instance, that in the U.S., large-scale demand response programs based on time-varying prices for residential and small business customers have moved from the pilot stage to recruitment of thousands of customers in Illinois. Florida Power and Light has a program with over 800,000 appliances under its control. Comverge, using a somewhat different business model, operates a successful residential demand response program for 60,000 customers in Connecticut.

increasing overall throughput. This in turn lowers the need for additional capital investment in poles and wires.

The ability to pinpoint blink-outs can result in marked cost reductions in vegetation management. Similarly, Smart Metering's help in identifying voltage fluctuations permits utilities to resolve these problems rapidly and improve customer satisfaction.

Utilities without Smart Metering report that 90 percent of all outages are first reported by customers.

Net metering

Many jurisdictions require utilities to reimburse customers for electricity they produce on-site and feed back into the grid.[3] The mechanism for accomplishing this is generally known as "net metering" because, typically, utilities subtract the amount of electricity produced from the amount of electricity the customer draws from the grid. The customer then pays (or receives) the "net" of that calculation.

The net metering terminology generally covers programs that spring from the concept of customer-produced energy even when the mechanism is not a "net" bill. Electricity fed into the grid may be monitored separately from the customer's consumption meter, and that generation may be separately reimbursed.

Some analysts posit a future in which batteries from parked cars will feed electricity into the grid.

Smart Metering is not a requirement for net metering. It significantly enhances the utility's ability to use customer production, however, by permitting the utility to monitor its flow into the grid in real time. Interval metering also permits a utility to reimburse a customer at the price prevalent on the wholesale market at the time the customer generated the electricity.

Environmental Improvements

Some environmentalists argue for Smart Metering on the grounds that it will improve the environment. Arguments include the following:

- Consumers who become more aware of their use through on-premises real-time displays will explore ways to reduce consumption.

[3] Net metering typically results from industrial co-generation and from use of home-based equipment like windmills, solar, and micro-hydroturbines.

- Time-of-use rates encourage customers to shift use to take maximum advantage of base-load electricity.[4] This reduces greenhouse gas production.
- Time-of-use rates also help even out grid use and thus reduce the need for habitat- and landscape-damaging grid expansions.
- Smart Metering adds additional tools to help maximize use of the existing grid and further reduce the need for environmentally damaging grid expansion. Analysis of interval data, for instance, permits engineers to fine-tune the grid and increase its capacity without running the risk of blackouts or voltage fluctuations. Two-way communications plus additional equipment can, with customer consent, permit utilities to turn down or off household appliances or business equipment when demand rises to clog grids.[5]

Smart metering can also reduce a utility's use of truck fuel that would otherwise be burned to:

- Transport field crews connecting and disconnecting meters.
- Respond to a "no service" call from consumers whose problems are not the fault of the utility.
- Search for the sources of outages.

Utility experience with responding to "false alarms" varies widely—from about 7 percent on the low side to more than 50 percent on the high side.

[4] "Base load" generation frequently remains unused at night, since it is inefficient or impossible to ratchet down production at coal and nuclear plants in response to lower off-peak energy use. Environmental damage results from base-load electricity whether or not customers use it. Time-shifting daytime electricity uses to night can thus reduce overall pollution in regions where daytime, frequently gas-fired generation ramps up in direct response to demand. Time shifting is indirectly applicable to water use in regions where utilities use electric pumps to raise water into a gravity-fed distribution system. Such utilities normally pump water at night using otherwise unused baseload generation. Overuse of water during the day, however, can force these utilities to turn on their pumps during hours of peak electricity consumption. This daytime electricity is likely to result in additional fuel consumption—generally natural gas—at the power plant.

[5] One assumes the utility is offering some sort of price or service concession in return for this control.

Smart Metering for Gas Utilities

Slower Adoption Rates

Smart Metering has been slow to penetrate gas utilities because:

- Gas distributors cannot use AMI's two-way communications feature to limit load by restricting flow through a meter. Such action would affect the pressure of the gas delivered to an appliance (and therefore appliance operation and safety).
- Remote reconnects would likely be hazardous because appliances that remained on following a disconnection or outage could, upon reconnection, permit gas to flow out into the building.
- All advanced gas meters require a power source. Batteries are the most common solution. Questions about battery life and the cost of replacement are unnecessary, however, in jurisdictions where gas meters may be linked to electrical systems.

Some jurisdictions have meter regulations that make it impractical to use a single meter for both gas and electricity. Removing those restrictions can increase the use of Smart Metering for gas.

Emerging Applications

Despite the limitations above, gas utilities are finding Smart Metering applications that work. For instance:

- One U.S. utility uses one-hour interval meters to monitor compliance from interruptible ("non-core") customers. It charges those who continue to take gas $1.00 per therm during the first five hours of the curtailment—a fine that ratchets up for those who continue to violate their contracts.
- The ability to check meter operation through polling can be of significant financial value to utilities whose employees must currently go door-to-door to relight pilots following outages.
- Net metering, while more common in the electric industry, can be used for gas, especially to encourage the capture and use of landfill methane. Gas quality issues (content standards for "pipeline-ready gas") make it more common, however, for customer-produced natural gas to be used on-site or in a nearby facility calibrated to the gas quality normally produced.
- The additional information provided by daily consumption measurement can help customer service representatives explain, for instance, the impact of cold weather on natural gas usage and the consequences for the monthly bill.

Initially, the utilities most likely to use Smart Metering for gas are those that combine electricity and gas service. This is especially true in jurisdictions that permit combination gas and electricity meters. Combined prepayment meters present opportunities for further savings.

For gas utilities, there may be a side benefit Smart Metering that raises peak electricity prices. Those higher prices may stimulate interest in such proven but slow-to-catch-on technologies as gas cooling. And net metering that pays producers market rates rather than averages could stimulate new co-generation and fuel-switching applications.

Steelmakers who switch from arc furnaces to pulverized core/natural gas alternatives could raise energy efficiency in the associated steelmaking processes from 17 to 66 percent.

Issues in Smart Metering

Where Should We Locate System Intelligence?

There is a continuing debate in the utility industry as to whether smart metering intelligence should be distributed or centralized.

Initial discussions of advanced metering tended to assume intelligence embedded in meters. Distributed intelligence seemed part of a trend, like "smart cards," "smart locks," and scores of other everyday devices with embedded computing that empowers consumers.

Embedding intelligence in the meter also made sense in an era when utilities traditionally handled meter data within the billing system. While some of today's robust billing applications are capable of handling the increase in data volume, it may be more efficient to handle the data demands of non-billing departments separately from the billing system.

Of course, placing intelligence in the meter may be equally or more costly.

Industry consensus appears to be coming down on the side of centralized intelligence. Why? Because while data processing for purposes of interval billing can take place in either distributed or central locations, other applications for interval data and related communications systems cannot.

Who Owns the Meter?

In regulated markets, this question rarely arises. Tradition dictates that utilities own the meter and have full responsibility for its proper functioning.

The question is far more difficult in deregulated markets, however. If deregulation is based on a concept of a retailer as "owning" the customer, one must then answer such questions as: How will the retailer recoup the investment when customers can readily change suppliers? How will retailers entice customers to switch to a time-based rate if the customer doesn't know their consumption pattern before the smart meter is installed? Few retailers have been willing to install smart meters in the face of these difficulties, and customers have, understandably, been unwilling to switch to a new supply scenario without an upfront savings guarantee.

One answer might be that retailers would be ordered to implement these meters. That undermines the concept, however, of a fully competitive market operating under regulations similar to those governing all businesses within a jurisdiction. It also begs additional questions like a retailer's ability to "recover" the cost of the new meter from the customer—a concept foreign to most competitive businesses.

A second alternative requires customers to buy and install interval meters. But the question then becomes: who is prepared to deal with millions of customers calling on an individual basis to order and pay for such a meter and to make arrangements for its installation? The complex logistics and costs of such a plan make it seem impractical from the outset.

Might regulators order a still-regulated distribution entity to install interval meters at every customer site and to recover the costs through distribution customer charges? Many jurisdictions in North America and Europe are actively pursuing this solution.

Questions about the ownership of meters and meter data can severely complicate consideration of Smart Metering.

Who Owns the Data?

In traditional, regulated utility models, utilities generally own meter data and can use it for any purpose approved by regulators, so long as they guard individual rights of privacy.

It is common, however, for deregulating jurisdictions to grant meter data ownership to customers. Customers grant data access to a chosen retailer or supplier as a condition of receiving supply.

Some see customer ownership of data as an impediment to full use of Smart Metering data. In some jurisdictions, advocates argue that customers should have the right to limit access to their data or should be compensated by parties using it. Jurisdictions moving forward with Smart Metering under both regulated and deregulated market conditions appear to resolve the issue by specifying conditions under which the various entities within the utility industry may access and use customer data

Can Ownership Arguments Be Resolved?

The arguments above regarding data and meter ownership may seem humorous or trivial. But they can have a significant bearing on the extent to which Smart Metering can incorporate a variety of programs with the potential to conserve water and energy and to reduce utility costs.

One could argue, for instance, that the reason Britain's Ofgem has limited Smart Metering objectives to "reducing greenhouse gas emissions, maintaining security of supply and tackling fuel poverty"[6] is because its system of meter ownership by retailers does not permit the broader programs possible in regulated jurisdictions. Given this situation, it is difficult to imagine how interval metering and two-way communication between utility and meter could prove cost-beneficial.

Handling Data Volume

Smart Metering inevitably increases the amount of meter data utilities must handle. In the residential arena, for instance, hour-long intervals that replace monthly consumption totals replace 12 annual reads per customer with 8,760. That's a 730-fold increase.

What hardware and software can handle that volume? And what new procedures will ensure that data processing flows smoothly?

The answers to those questions spring in part from current utility organizations. In most utilities today, billing departments "own" metering data because the primary use of monthly consumption is to bill customers. While other departments have sought data access, few legacy billing systems were able to provide it in the time or form needed.

Modern billing systems can more easily provide data to other departments. But the pressure to do so in a timely and complete manner increases when a utility moves to interval metering. Departments using the data to address load size and shape, monitor voltage, or receive outage signals cannot wait for days or weeks for the billing system to supply the needed data. At the same time, forcing the billing department to respond quickly to demands of other departments may slow bill production and the associated utility cash flow.

The increase in data volume associated with Smart Metering forces utilities to consider the overall structure of their IT systems.

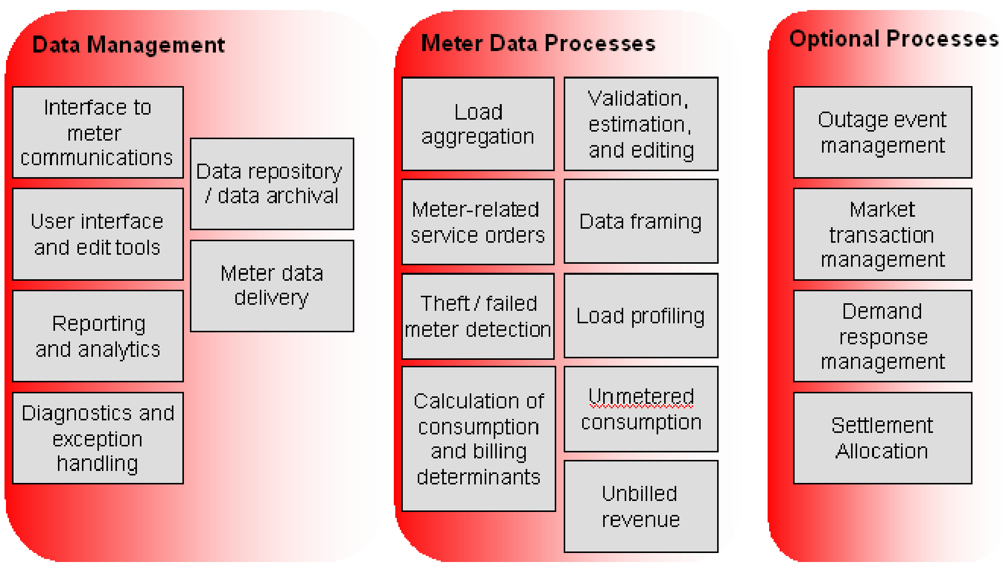
[6] Decision Document: *Domestic Metering Innovation – Next Steps*, Ref: 107/06, 30 June 06, http://ofgem2.ulcc.ac.uk/temp/ofgem/cache/cmsattach/15591_Metering_Innovation_Decision_document_final.pdf?wtfrom=/ofgem/whats-new/archive.jsp. The document demonstrates Ofgem's commitment to the competitive status quo: "suppliers are best-placed to understand the costs and benefits to different types
of customer and deliver the types of meters that customers' want."

Meter Data Management

An alternative way to handle data volume and multiple data requests is to offload it into a stand-alone meter data management (MDM) application.

MDM gathers and stores meter data. It can also perform the preliminary processing required for different departments and programs. Most important, MDM gives all units equal access to commonly held meter data resources.

Meter data management provides an easy pathway between data and the multiple applications and departments that need it. It can more easily consolidate and integrate data from multiple meter types. It can reduce the cost of building and maintaining application interfaces. And it provides a place to store and use data whose flow into the system cannot be regulated, such as the flood of almost simultaneous messages from tens of thousands of meters sending a "last gasp" during a major outage.



Meter Data Management typically encompasses a number of related functions.

MDM's independent service function may be further refined through the addition of a meter data warehouse. In situations where both exist, the MDM typically manages real-time, transactional processing while the warehouse handles data extraction, reporting, and analytical processing.

Separating the MDM from the billing solution has clear advantages. It maintains bill production efficiency while providing even-handed data access to all departments. It permits a utility to add security to meter communications and data without complicating customer access to bill payment and analysis websites. And it lets utilities change the source of the meter data with no negative effect on other IT systems and architecture.

Meter Data Management applications are gaining popularity as a way not only to handle data volume but also to facilitate cross-departmental business processes.

The IT Implications of Meter Data Management

MDM is, for most utilities, a new type of application. It shatters the typical utility IT model in which each department "owns" its own set of applications.

MDM treats every department as its "owner." It thus forces departments to work together. If MDM is to serve all equally efficiently, then the various stakeholders must share information. They must agree to application configurations that serve all needs optimally.

This process of information sharing is proving eye opening to departmental heads. Suddenly, sharp minds have the knowledge and tools to propose better, more efficient program administration.

In other words, MDM is becoming an avenue for rethinking utility business processes independent of existing departmental boundaries. It is the first major utility silo-breaking application.

Adoption of MDM

The MDM concept is rapidly catching on. A new Chartwell study[7] finds that 15 percent of utilities with fewer than half a million customers and 17 percent of those with more are already using MDM as metering data repositories. Even more startling for such a relatively new idea, 47 percent of the largest utilities are in the planning stages of MDM, and another 35 percent are considering the approach.

Movement toward MDM is considerably less marked at smaller utilities. The same study shows that 89 percent of utilities with fewer than 100,000 customers currently use their billing/customer care (CIS) systems as meter data repositories and that most (62 percent) are not even considering a change at this point.

[7] "Chartwell research shows MDM consideration more prevalent among larger utilities," Industry Update: Metering Research Series, September 28, 2007.

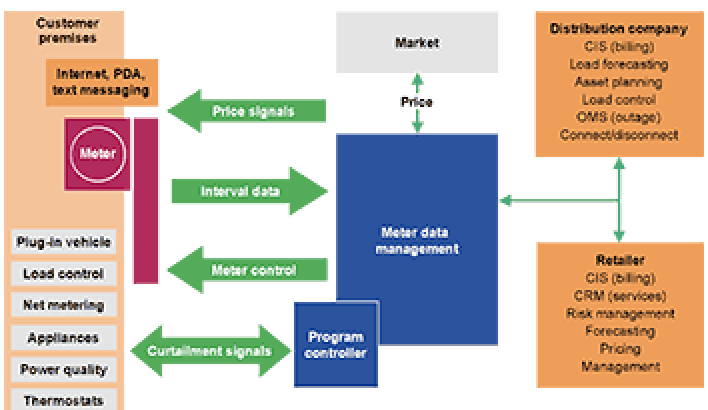
Chartwell provides an explanation when it compares cooperatives in its study with large investor-owned utilities:

Cooperatives are smaller and therefore have fewer metered endpoints. They have smaller budgets and fewer back-office business requirements and needs.

A larger IOU with more than one million customers typically will have several departments staffed with specialized employees that, with the advent of advanced metering, now have a stake in the data. On the other hand, a cooperative with 17,000 members will have fewer departments staffed with employees who have extra-departmental duties and tasks.

UtiliPoint analyst Patti Harper-Slaboszewicz maintains four key elements of MDM must be present for the product to be called MDM:

- The functionality must be offered as a stand-alone product and not only as part of the vendor-specific CIS/ABS and/or AMI head-end system.
- The stand-alone product must be able to accept meter readings from any meter data collection method (or the vendor must be able to develop an interface within a reasonable amount of time).
- The stand-alone product must be able to interface, with two-way data sharing, with any utility legacy or vendor supplied CIS, outage management, work force management, GIS, or other key utility IT system (or the vendor must be able to develop an interface within a reasonable amount of time.)
- The data must be persistent, and versioned.



Smart metering is an entire system that supports many customer and utility uses.

Source: Energy Insights, Smart Metering Update, June 2007.

Expanding the Concept

Independent applications serving multiple departments are not, of course, the only software approach to breaking down departmental barriers. Application integration has long played a role, though its expense has prevented utilities from developing a full complement of data interchanges that could better pierce departmental barriers.

Far less successful were attempts to develop composite applications, popular a few years ago. Composite applications, consisting of individually addressed functional modules, were touted as a major breakthrough to cross-organizational business processing. Advocates foresaw a significantly lower total cost of ownership.

Software developers soon realized, however, that multiple applications calling on each other's functions more or less randomly were unlikely to facilitate cross-organizational business flow. A more probable result was computing resource chaos.

MDM avoids that chaos while also moving beyond simple software integration. It did not originate as a conceptual computing innovation. Its origins were strictly pragmatic—the need to handle efficiently a potentially huge increase in data volume. It has evolved, however, into something much larger.

MDM, by providing both unique and common resources to multiple applications, has the potential to advance the quest for multi-departmental business process orchestration. If it succeeds in this role—as it very likely will—other functions may quickly follow suit. Scheduling, for instance, might be pulled out of asset management, field management, and appointment setting and consolidated into a single instance that serves multiple departments.

Multi-departmental applications like MDM, owned cooperatively among departments rather than individually, could thus be the "missing link" to facilitate the smooth flow of business processes across the organization. They could prove a process orchestration concept that increases the efficiency with which utilities serve all stakeholders.

Weighing Smart Metering's Costs and Benefits

While discussion of smart metering abounds, many utilities hesitate when they see the large financial commitments involved and the uncertainties of customer response. Will they be able to recover the costs? Will they find themselves on the bleeding rather than leading edge of technology?

There are ways, however, to mitigate the risks involved.

Including All Potential Benefits

Smart metering may be hard to cost justify if it rests solely on customer acceptance of demand response. It is easier to cost-justify when it includes, for instance, the value of:

- Meter polling during outages.
- Remote programming that enables customers to use new products that might be offered by the utility or by a third party.

- Fewer meter readers, which means lower total costs for salary, benefits, and workers compensation.
- Remote rather than expensive and occasionally risky on-site disconnects.
- Less wasted time in attempts to pinpoint the size and source of an outage.
- Lower risk to public safety from downed power lines and lack of exterior safety lighting during outages.
- Better accuracy in the actual meter readings, resulting in fewer calls to the contact center.

Likely Benefits	**Benefit accrual of AMR systems** (✓,✓✓, ✓✓✓ - Low, Medium, High)							
	Customers	Energy Supplier	Meter Operator / Management	Distribution	Transmission	Generation	National Governments	EU
Improved energy use visibility	✓✓✓	✓✓					✓	✓
Reduced metering costs		✓✓	✓✓✓					
Streamlined switching process	✓✓	✓✓✓					✓	✓
Reduced customer services / billing	✓	✓✓						
Better debt management	✓✓	✓✓						
Improved outage & demand management		✓✓		✓✓	✓✓	✓	✓	✓
Improved customer analytics		✓✓		✓	✓	✓	✓✓	
Improved load forecasting				✓✓	✓✓	✓✓	✓✓	
Improved investment decisions	✓		✓✓	✓✓	✓✓	✓✓✓	✓✓✓	✓✓
CO2 Reduction		✓		✓	✓	✓✓	✓✓	✓✓

Source: Datamonitor DATAMONITOR

In a study done for the European market ("The impact of smart metering on the Energy and Utilities market", June 2007), Datamonitor finds that advanced metering provides significant benefits across all energy-industry stakeholders.

Analysts at Gartner note, "Because of the uncertainty in AMI investment recovery — particularly in the area of energy efficiency programs and societal benefits — many utilities start with AMI deployments that target utility-related benefits, while making sure that other benefits (be they customer, market or societal) can be achieved with incremental investments in the base AMI systems. That approach requires that the initial solution be upgradeable and subject to a phased implementation approach."[8]

[8] Gartner Inc., "Advanced Metering Infrastructure, Part 1: Business, Regulatory and Technical Considerations," Zarko Sumic, 28 September 2007.

Evaluating Pilots

Utilities normally test customer response to proposals like demand-response programs through pilots. Unfortunately, technology annuls are full of stories about successful pilots followed by unsuccessful products.

It's difficult to narrow the gap between a test and real life. Pilots frequently protect participants from harsh financial consequences. And it's difficult for utility personnel to avoid spending time and attention on participants in ways that encourage them to buy into the program. Real-life program rollouts must include customers with sufficient customer support to successfully recruit customers.

Complicating the problem are likely differences between long-term and short-term behavior. The history of gasoline conservation programs suggests that while consumers initially embrace incentives to car pool or use public transportation, few make such changes on a permanent basis. As utilities travel this path, they must also include customer retention expenditures as a cost item.

Examining the experience of utilities in Italy or the U.S. states of California, Illinois and Idaho, which are gaining experience with large-scale Smart Metering and demand response programs, will provide additional information.

Developing the Business Case

Determining the cost-benefit ratio of Smart Metering is challenging. Some costs—meter prices, installation charges—may be relatively easy to determine. Others require careful calculations; when interval meters replace time-of-use meters, how does the higher cost of interval meters compare with the fact that they do not require time-of-use manual reprogramming?

Some utilities cost-justify Smart Metering by assuming new customer fees that, for residential consumers, can run as high as five percent of the average monthly bill.

As in any business case, some costs must be estimated:

- What is the break-even point for customers agreeing to a specific demand-response program? Will that number of customers sign up?
- How long will meters last under our specific conditions, and how well will they operate? How will we handle an unexpectedly large number of customer requests for meter testing?
- Will we undertake retraining of current meter readers, and what will that cost?
- Will Smart Metering help us retain customers we might otherwise lose?
- Can we offer new services, such as equipment efficiency analyses, and how much can we charge for them?

Because some utilities are already rolling out Smart Metering programs, it is increasingly easy to obtain real-life numbers rather than estimates to plug into your business case.

Considering Alternatives

Interval meters with two-way communications networks may not be the only solution for some Smart Metering objectives. Utilities may find it valuable to try lower-cost routes to some results, for instance:

- Customer charges to prevent unnecessary "truck rolls." Such fees are common among telephone service providers and have worked well for some gas utilities that found themselves responding to repeated false alarms from householder-installed carbon monoxide detectors.
- Time-of-use billing with time/rate relationships that remain constant for a year or more, giving consumers opportunities to make time-shifting a habit.[9]
- Urging customers to use the time-shifting features on their appliances as a contribution to the environment. Most consumers have no idea that electricity goes to waste at night. Keeping air clean and transmission towers out of the landscape could be far more compelling to many consumers than a relatively small saving resulting from an on- and off-peak pricing differential.
- Month-to-month rate variability. One study found that approximately a third of the efficiency gains from real-time interval pricing can be captured by simply varying the flat retail rates monthly—and at no additional cost for metering.[10] While a third of the efficiency gains might not be enough to attain long-term goals, they might be enough to fill in a shorter-term deficit, permitting technology costs and regulatory climates to stabilize before decisions must be made.
- Multi-tier pricing based on consumption. Today, two-tier pricing is common.[11] Three or four tiers might capture the attention of at least some customers with particularly high consumption—owners of large homes and pool heaters, for instance—without burdening those at the lower end of the economic ladder. Tier structures, however, have proved difficult

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[9] Note, however, that when price differentials are small, few customers appear willing to change usage patterns.

[10] Holland and Mansur, "The Distributional and Environmental Effects of Time-Varying Prices in Competitive Electricity Markets." Results published in "If RTP Is So Great, Why Don't We See More Of It?" *Center for the Study of Energy Markets Research Review*, University of California Energy Institute, Spring 2006. Available at http://www.ucei.berkeley.edu/.

[11] That is, a lower rate for the first few hundred kilowatt-hours per month and a higher rate for additional hours.

to explain, and month-to-month variability in consumption may hide the benefits from the average consumer.

How Oracle Helps

Oracle's staff of utility experts can provide extensive advice and guidance on Smart Metering pilots and projects, based on the experience of working on such projects with customers around the globe.

Oracle also provides software applications that can form the heart of a Smart Metering system:

- **Oracle Utilities Customer Care and Billing** is a complete billing and customer care application for utilities serving residential, commercial, and industrial customers. It can handle all Smart Metering programs for some or all customer classes on a stand-alone basis or in conjunction with a Meter Data Management application.
- **Oracle Utilities Meter Data Management** decouples the handling of meter data from other mission-critical utility operations. This permits all other applications to receive the information they need in the format needed while speeding such time-critical operations as network repair.
- **Oracle Siebel Customer Relationship Management** can help those utilities moving to Smart Metering but unable to replace the current billing system. It can track customer participation in various Smart Metering programs, gauge market response to various incentives for program membership, identify prospective customers for various programs, and analyze program results. Utilities using Oracle's E-Business Suite, PeopleSoft, or J.D. Edwards enterprise applications have additional suite-specific customer relationship management options for handling these tasks.
- **Oracle Utilities Customer Self-Service** helps customers maximize the benefits of Smart Metering by providing ways to display and analyze consumption in near-real-time via a personalized website. These websites can also provide advice tailored to a customer's circumstances and objectives.
- **Oracle Utilities Mobile Workforce Management** ensures that field crews and dispatchers use all of the data provided by Smart Metering to reduce the number of unnecessary service calls.
- **Oracle's Asset Management** applications help utilities track and compare the performance of various brands and types of Smart Metering equipment. They also ensure that warranties remain in effect and that field crews arrive for Smart Metering repairs with the right equipment and the right people to complete the task.
- **Oracle Projects** can help manage the deployment of meters and other equipment essential to Smart Metering programs.

- **Oracle's Business Intelligence** applications ease the process of tracking project and program performance objectives and help utilities readily answer questions from customers, program managers, utility executives, and other stakeholders, such as investors, regulators, and regional governments.
- **Oracle Spatial** maximizes the use of geographic information within the Smart Metering context. It fosters map-based tracking of meter location. It aids in understanding the geographic market penetration of new programs like Demand-Response. By facilitating map-based presentations of Smart Metering data analyses, Oracle Spatial significantly speeds analysts' comprehension of their data and their ability to present complex concepts to audiences of varying interests and analytic backgrounds.
- **The Oracle 11g Database, Fusion Middleware and associated Enterprise Manager** products address such compelling IS infrastructure needs as:
  - Security of both data and user access throughout the data collection and processing processes, to ensure confidentiality of both customer data and utility operations.
  - Comprehensive business system management to ensure high operational service levels, pro-actively identify issues, and resolve them.
  - Data management scalability and the ability to deliver a consistent performance, even at very large data volumes of tens or hundreds of terabytes.
  - High availability to guarantee data collection / validation / aggregation and thereby support time-critical Smart Metering applications.
  - Use of an Enterprise Service Bus for rapid and cost effective service orientated architecture integration of meter data with other systems.
  - Flexibility to rapidly configure and deliver when circumstances change—in essence, "future proofing" your long-term investment in Smart Metering and in Oracle.

Oracle works closely with communications and metering partners to ensure seamless project planning and pre-integration of solution components.

Conclusion

There is every reason to believe that Smart Metering will replace most of today's electromechanical metering approaches within the foreseeable future. At today's prices, many utilities are constructing conservative business cases that foresee a relatively short five- to six-year payback period for Smart Metering investments. Rapidly falling prices and the multiple advantages to both customers and utilities should make the systems even more compelling.

As a result, prudent utilities worldwide are increasingly factoring Smart Metering into long-term IT and customer-program strategies.

Interval meter prices are falling. As a result, it is increasingly easy to cost-justify Smart Metering.

Appendix: Types of Meters

- Electromechanical meters record total consumption as a single number read by a human meter reader and reported to a utility.
- Electromechanical time-of-use meters use a clock mechanism to record consumption in (generally) three to five time "buckets" designated as peak, off-peak, shoulder, etc. Prices vary according to the time of consumption.
- Meters in an automatic meter reading (AMR) system broadcast meter-identification information and consumption totals in response to a command. They may send totals at programmed intervals to pole-mounted collectors that in turn transmit the reads wirelessly to a utility. They may broadcast their information in response to a truck-mounted collector. Other AMR communications technologies involve power lines, satellites, or telephones.
- Communicating meters are of various types. In AMR systems, communications are generally one-way—from meter to utility—and activated only on command from the utility. More advanced systems frequently offer two-way communications that permit the utility to, for instance, disconnect the meter as well as to read it remotely. The communications link may be always on or it may be activated by one or both parties (utility and meter). Activation from the meter permits "last gasp" messages alerting the utility to outages.
- Net metering records energy flow both onto and off of a premise (the latter from some on-site energy source, such as a windmill, methane-producing landfill, or solar panel). The system may involve one or two meters. It may record simple consumption and production totals. Or, in the case of some electricity net metering, it may record time of energy production and then compensate the producer at the market value of the electricity at the time it was produced.
- Prepayment meters require the customer to pay prior to consumption. In the 20th Century, prepayment meters generally accepted coins. Today, most use tokens or cards that can be "recharged" at a kiosk or bank or via telephone or Internet.
- Interval meters record separately the consumption during individual time periods. At industrial sites, they typically record a separate electricity consumption number of each quarter- or half-hour. Residential interval billing for electricity may involve intervals between 15 minutes and an hour long. Interval metering for gas and water typically uses 24-hour intervals. Readings can be stored in the meter and communicated at set intervals or on demand. They may also be communicated at the end of each interval. Advanced, programmable interval meters may do some data processing prior to communication.

Smart Metering for Electric and Gas Utilities
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